(12) UK Patent Application (19) GB (11) 2 210 396 (13) A

(43) Date of A publication 07.06.1989

(21) Application No 8822581.8

(22) Date of filing 26.09.1988

(30) Priority data
(31) 3738248 (32) 01.10.1987 (33) DE

(71) Applicant
Swecom Reefer AB

(Incorporated in Sweden)

S-451 82 Uddevalla, Sweden

(72) Inventor
Anders Rosen

(74) Agent and/or Address for Service
Potts Kerr and Co
15 Hamilton Square, Birkenhead, Merseyside,
L41 6BR, United Kingdom

(51) INT CL⁴
E04B 1/76

(52) UK CL (Edition J)
E1D DCF2 DF193 D1072 D2141 D401 D421 D523 D903
U1S S1700 S1958

(56) Documents cited
None

(58) Field of search
UK CL (Edition J) E1D
INT CL⁴ E04B, E04C

(54) Heat-insulating wall panel using two different plastic foam materials

(57) A heat-insulating wall element has two thermoplastic foam materials adhered between two hard panels formed from metal or plastics material, the one 3 with the higher density at the edges of the panel, and the other cheaper thermoplastic foam material 4 forming the insulating material enclosed by the other parts of the panel. An adhesive 2 may be used.

FIG 1

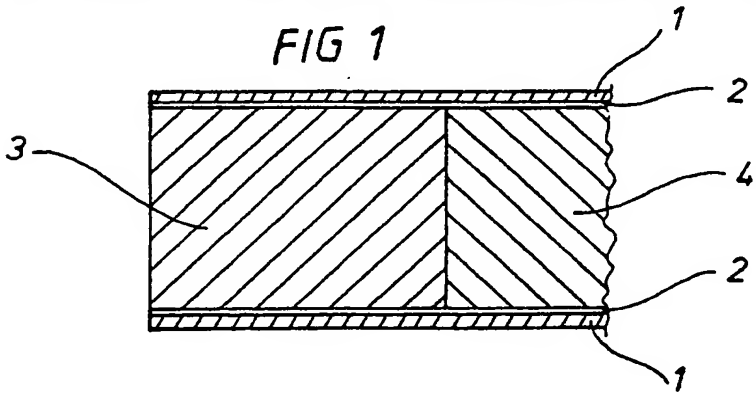
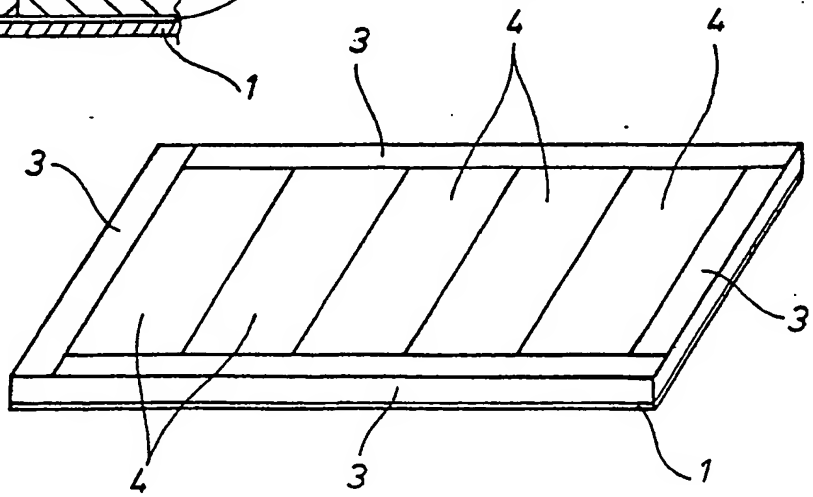


FIG 2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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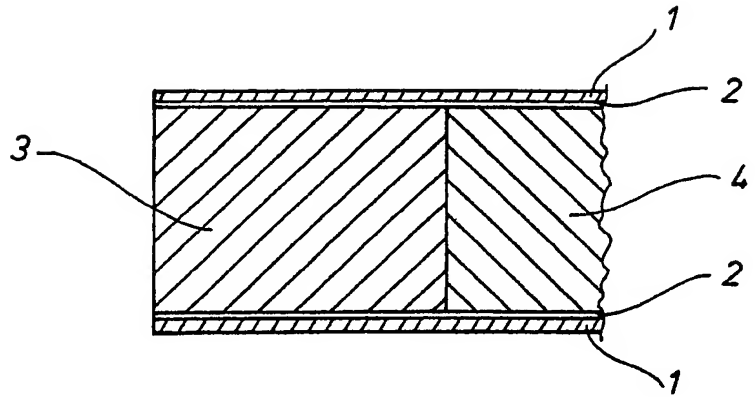

FIG 1

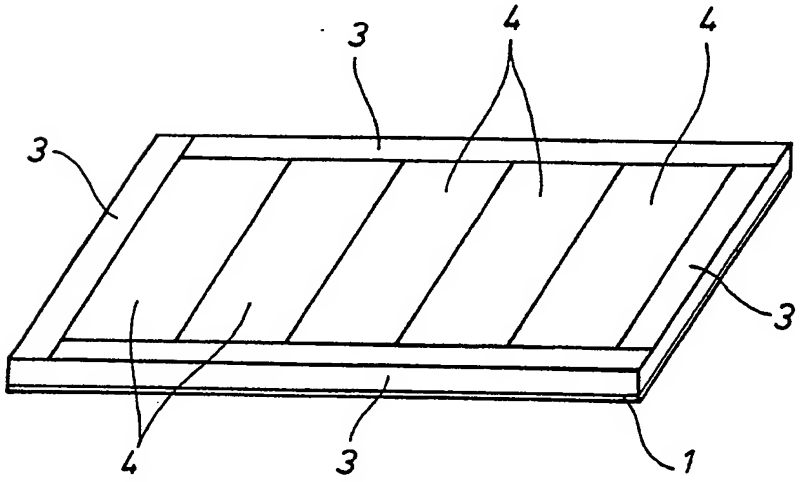

FIG 2

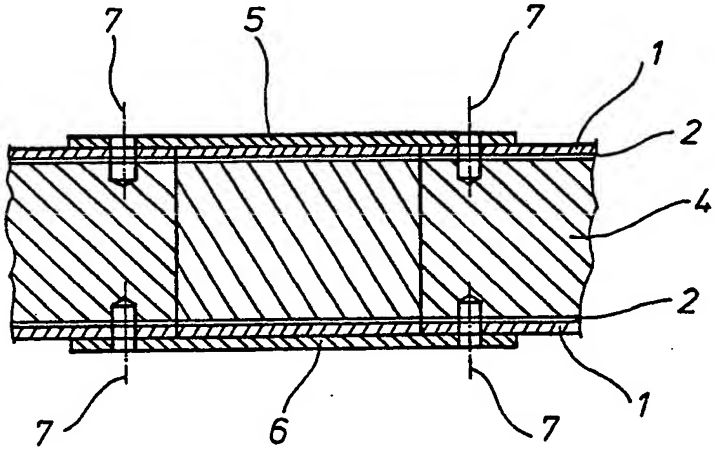

FIG 3

A LARGE,HEAT-INSULATING WALL ELEMENT

Many foodstuffs are sensitive to cold. These include, inter alia, potatoes and tomatoes. Other foodstuffs have to be kept cold. Even intense cold is required for many foodstuffs, such as, for example, deep-frozen goods. Nowadays, such foodstuffs are transported over long distances. The transportation costs are also dependent upon the energy which is required to maintain a specific temperature in the interior of a container, for example. In consequence, high demands are made for containers and lorries to be satisfactorily insulated for the transportation of foodstuffs.

In this technical field, the present invention now proposes an insulating wall element which is intended for containers in particular, and wherein other operating conditions are also taken into consideration by the choice of raw material.

Rock-wool has mainly been used hitherto because it provides better insulation than sawdust. Both these materials have hygroscopic properties. If the insulation becomes wet, the insulation attracts more fluid and, in consequence, loses its insulating effect. Polyurethane, PUR, is a material which is significantly lighter in weight, is less hygroscopic and has the advantage that it also acts as a bonding material and adheres firmly to sheet steel, for example. It has been possible, therefore, to produce wall elements with an excellent insulation property and a low hygroscopic capacity by using polyurethane as the starting material. During the production of

insulation layers, polyurethane has the property that, when two chemical components are mixed, a gas is produced which causes the mixture to foam. Without any limits being set in all directions, the foaming process would continue until a chemical state of equilibrium is produced without gas being given-off. In practice, the foaming is interrupted as a result of high pressure acting on the mixture, e.g. between two steel plates of a multilayer press. In the boundary area between the steel and PUR, a skin usually forms which can produce a thermal bridge between material which is otherwise porous. The greatest disadvantage is that it is very difficult to repair any damage, since both sides of a wall element need to be placed under pressure for the repair operation, since thermal bridges would otherwise occur again. Another disadvantage resides in the fact that the porosity cannot always be controlled in the interior of an element, where air pockets may occur.

Many thermoplastic materials may be filled, in their warm state under high pressure, with any gas whatsoever, such as nitrogen or freon, which causes the plastics material to foam when there is a pressure drop. There are good possibilities here for effecting better dosing than with PUR. It follows therefrom that there is no leakage of gas, such as is the case with PUR. A smaller hygroscopic tendency can also be ascertained.

This knowledge of materials is utilised in the present invention. It is also taken into consideration that, compared with polyurethane, for example, thermoplastic materials can have better resilient properties in wall panels.

Two kinds of thermoplastic foam materials are typical of today's market in respect of insulating materials. Polyvinyl chloride (PVC) foam comes very close the the ideal material for meeting the demands of insulating power and durability. Unfortunately the material is expensive when compared with polystyrene foam. With present-day technology, polystyrene foam often has better insulation properties, but it does not have the strength and bearing capacity which is required, above all, for sea shipment using insulated containers.

A wall element of the above-described type is already known from German Offenlegungsschrift No. 2 731 604. However, various polyurethane mixtures are merely used therein for the core and the frame portions, the frame portions having a higher density and strength than the core. The wall elements thus produced are disadvantageous, however, in that they are relatively sensitive to moisture and they are less resilient, especially in the edge region, but they are disadvantageously susceptible to fracture there.

In another known wall element as claimed in US Patent Specification No. 3 785 103, the edge region is provided with wooden strips which are gripped externally by bent portions of the hard panels. The wall elements, however, are disadvantageous in that they are relatively expensive.

Accordingly, the object of the present invention is to provide a wall element of the above-described type such that, whilst being relatively inexpensive to manufacture, the wall elements are extremely strong, yet resilient throughout; considerable resistance is achieved relative to the influences of moisture; and, in the event of damage, the wall elements can be easily repaired, without the stability being impaired.

According to the present invention, there is provided, a large, heat-insulating wall element, constructed from two outer, hard panels which surround two insulating thermoplastic foam materials, the one with the higher density forming a frame around the other thermoplastic foam material with the lower density, wherein glue is, in known manner, the bonding agent between the hard panels and the insulation layer situated therebetween, in which the edge strips are formed from polyvinyl chloride foam, and elsewhere the rest of the insulating thermoplastic material is made of polystyrene foam.

In pursuance of the invention, the wall elements of the invention are intended to be used for containers of particularly large volumes.

A characterising feature of the insulation wall element according to the invention is that polystyrene foam is used as the insulating material. The polystyrene is adhered to protective panels formed from sheet steel or plastics material. The panels, spaced from one another, are extremely strong and form lamellar-structured beams in known manner. The polystyrene, which is mechanically weak, is reinforced with polyvinyl chloride foam, PVC foam, around the edges of the elements.

Another characterising feature of the wall element according to the invention is that the element can be repaired when an element of identical cross-section is glued securely as a replacement for a cut-away, damaged portion of an element. It is thus possible to use the wall element of the invention, without any reinforcement, in flat areas which are greater than 5 m along the largest side, if the area forms a parallelogram.

The present invention will be further illustrated, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view through the edge of a wall element where both styrene foam and PVC foam are visible;

Figure 2 is a perspective view of a wall element before the protective cover layer of one side, formed from steel or plastics material, has been applied and securely glued in position; and

Figure 3 is a cross-sectional view through a repaired location of the wall element.

A characterising feature of insulating material is the large amount of gas which exists in one form or another and is bound in the material. The smaller the gas bubbles, the better the material. As the person skilled in the art is aware, large bubbles permit the gas to flow in a bubble and to effect heat convection.

Polyurethane generally has gas bubbles of identical size but, with the method of producing the wall elements, it is difficult to decide whether the volume between two protective panels is full or has air pockets.

The manufacturing method is also distinctive for the wall element, wherein prefabricated PVC edge strips are securely glued to a rigid, protective panel, which is generally formed from steel and is preferably formed from stainless steel. Reinforced plastics materials may also provide the same protection. In this case, one starts with one side of the wall element and securely glues the edges and the main insulating material, polystyrene foam. The construction is clearly shown in Figure 1 with one edge of a wall element.

Figure 1 also gives some idea about the proportions of the insulating material and the protective surface covering. The first panel 1 in terms of manufacture is covered with a layer of glue 2 which is shown by continuous, unhatched lines in the Figures. A corner 3, made of PVC foam, is then placed in the layer of glue. Panels 4 of polystyrene foam are now glued along the whole length of the wall element. The panel boundaries of the styrene can clearly be seen in Figure 2. Subsequently, the diagonally opposed corner of the wall element is covered in polystyrene foam. It has proved advantageous to glue also the edges of the panels which are in contact with polystyrene.

It is obvious to the person skilled in the art that the same result is achieved if the glue is applied to the plastics material panels instead of to the protective panel. In particularly delicate cases, it may be advantageous to apply glue both to the protective panels and to the insulation panels. In difficult cases of insulation, tongue and groove joints may also be employed.

The laminate, which is thus produced and which comprises a rigid, hard panel covered with an insulating layer of plastics material foam, has a low bending resistance and needs to be used on a flat base. However, it has a substantial advantage over the use of polyurethane or other chemically foamed insulating wall elements. It is in fact apparent with the naked eye that the whole wall element surface is covered with a porous, insulating layer. No air pockets can be formed, not even in the

finished wall element. A fastidious customer can have this ascertained through his quality controller.

In the next operation, glue is applied in known manner, whereupon an upper, protective, hard panel is placed upon the plastics material foam. The wall element is now finished. The last panel to be applied provides the wall element panel with bending strength and resilience. The wall element of the invention can be manufactured according to this method in large sizes 5 m x 1.75 m and larger. The possibility of producing large wall elements without any risk of air pockets being formed is a feature of the method according to the invention and of the finished wall element.

When the finished wall element is studied, only two relatively thin, hard panels are found, with a layer of plastics material foam situated therebetween. Such elements have been known for a long time. If they were only constructed of polystyrene, the strength would be too low to permit the wall element to be assembled along its edges and, in consequence, securing clamps would be necessary, and this would lead to considerably more expense. If PVC foam is used instead over the whole area, the costs of insulation would be approximately five times higher than if styrene were used; the strength, however, would be adequate. A known, technical problem has been solved by the present invention in an economically viable manner. This applies, in particular, to shipment containers where polyurethane was previously used, despite the occurrence of disadvantageous air pockets.

The thermoplastic materials used in the wall element of the invention permit the use thereof in sides and tops of containers, without the need for supporting struts in the middle of the side and top areas, this being a substantial, economic advantage for the manufacturing operation. Unfortunately, despite the built-in strength, it very often happens that careless handling of the containers leads to the insulation layers being damaged. An additional advantage of the wall element according to the invention is apparent here. A damaged element can be repaired in a simple manner.

In the case of older designs where polyurethane was used. A damaged insulation layer would have had to be scraped away from the damaged area and pressure panels would have had to be applied above the hole as support means for an injected quantity of urethane and isocyanate - a method which is known to the person skilled in the art and is very time-consuming. Figure 3 shows one example of how easily a repair can be effected. In a wall element of the same construction as in Figure 1, a hole has been cut around a damaged area by known means, e.g. a cutting roller. A precisely measured piece of the same construction as the damaged element is inserted into the hole. Glue is applied to the edges of the piece before the repair piece is mounted at the intended site. The hole is covered on each side with a glued-on steel plate 5 and 6 respectively. Through-holes are drilled through each hard panel, whereupon the repair piece, which has been glued in position, is fixed by explosive riveting. The site

intended for explosive rivets is denoted by 7 in the Figure. The person skilled in the art can effect this form of repair in various ways. The possibility of doing so, however, depends substantially on whether thermoplastic materials have been used in the insulation layers and not chemically foamed plastics materials such as polyurethane.

The thermoplastic materials used are advantageous because of their behaviour in relation to water. A low hygroscopic capacity can be ascertained. This is particularly valuable in the event of any damage occurring. Polyurethane, however, attracts approximately 10% of its volume during a ten-year period in which the hygroscopic capacity of the materials used can scarcely be measured. It has proved advantageous to use polystyrene which has been foamed to a density of approximately 40 kg/m^3, for example the material known as Ecoprim manufactured by Rockwool. The density of 60 kg/m^3 has proved advantageous for the foamed PVC edge around the element, and in particular so has the material known by the commercial name of Divinycell. This harder material is primarily suitable for screw fastenings in containers or delivery lorries and in similar vehicles where demands are made for good insulation and low weight. It is obvious to the person skilled in the art that the weight can be reduced when the protective, hard panels are made of aluminium instead of stainless steel, which is the most suitable material. A low

weight can also be achieved with reinforced plastics material.

The characterising feature of the present invention is that insulating wall elements can be constructed at low cost for units as large as 20-foot containers, where the sides can be manufactured in one piece without additional, supporting struts. The invention also permits the insulating part in the wall element to be inspected during manufacture, so that the absence of air pockets can be ascertained. In addition to achieving economic viability, a low hygroscopic capacity is also achieved when two thermoplastic materials are mixed.

CLAIMS

1. A large, heat-insulating wall element, constructed from two outer, hard panels which surround two insulating thermoplastic foam materials, the one with the higher density forming a frame around the other thermoplastic foam material with the lower density, wherein glue is, in known manner, the bonding agent between the hard panels and the insulation layer situated therebetween, in which the edge strips are formed from polyvinyl chloride foam, and elsewhere the rest of the insulating thermoplastic material is made of polystyrene foam.

2. A large, heat-insulating wall element as claimed in claim 1, in which the portions which are made of polystyrene foam are disposed so as to be closely adjacent one another in a similar manner to beams or boards.

3. A large, heat-insulating wall element as claimed in claim 1 or 2, wherein damaged wall elements which have identical cross-sections are cut-out for repair purposes, intact wall elements of identical dimensions and with external hard panels are inserted, and retaining panels are secured to the outside of the damaged location.

4. A large heat-insulating wall element, substantially as hereinbefore described with reference to the accompanying drawings.

5. A container or like large volume housing comprising a plurality of heat-insulating wall elements as claimed in any preceding claim.

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